

REMARKS

This responds to the Office Action mailed on November 1, 2005. By this amendment, claims 1, 4, 7, 11, 12, 21, 23-27, 31, 33 and 38 were amended, and claim 34 was canceled. No claims were added. As a result, claims 1-13, 21-27, 31-33 and 35-40 are now pending in this application. Reconsideration of this application in view of the above amendments and the following remarks is requested.

§112 Rejection of the Claims

A. Rejection: Claims 26-27, 31-34, and 39 were rejected under 35 USC § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

B. Response: Applicant submits that the specification does in fact enable one skilled in the art as to how to make and use the invention. FIGS. 5a to 5D and the discussion related to FIGS. 5A to 5D, set forth specific steps. The end result is the structure that includes the joint 440 shown in FIG. 4B. The following paragraph, among others, describes the last step in achieving the joint 440 shown in FIG. 4B:

“FIG. 5D illustrates still another stage during the process of formation of a via 400 in a semiconductor device, according to an embodiment of this invention. As shown in FIG. 5D a laser 560 directs a laser beam 562 toward or at the base 404 of the via or feature 400. The laser energy is depicted by the dotted arrows carrying the reference numeral 562 dotted arrows carrying the reference numeral 562 depict the laser energy. The laser energy 562 heats the joint area 440 to a range of approximately 400 to 600° C. The directing of the laser beams 562 toward the joint area 440 is also referred to as laser brazing. Laser brazing enhances diffusion of the interfacial adhesion materials, such as palladium, into the electroless layer 414 and into the electrolytic copper layer 412 and the electrolytic layer 418. The laser has a diameter d_l , which is approximately half the diameter of the diameter of the base 404 depicted by d_B .” (See page 8, lines 1-11 of the Specification).

FIG. 4B shows a tooth-like structure. The discussion in the specification portion also discusses the tooth-like structure and the individual teeth. As a result, applicant feels the discussion as well as the FIGs. and the original claims enable one skilled in the art as to how to form the tooth-like structure. As a result, claims 26 and 27 are enabled and overcome the Examiner's 35 USC 112, first paragraph rejection.

There is no real discussion of a uniform structure. The claim language is to the nonuniform teeth-like structure shown in the FIGs. and described rather than to a uniform structure that the Examiner seems to feel must be described. Accordingly, claim 31 is also felt to be enabled.

With respect to claim 32, the Examiner contends that there is no explanation of how the solid solution is formed. The specification includes a phase diagram showing that "...a Cu-Pd solid solution is formed at much lower temperatures than the temperature produced by directing energy from the laser 560 to the base 404 of the via 400, as shown in FIG. 5D above. At various weight percentages of Copper and Palladium, various phases of the compound of Cu-Pd are formed. The palladium forms a solid solution with the copper. In some embodiments the interfacial adhesion material 450 (shown in FIG. 4) interdiffuses with the conductive material 412, 414, 418 (shown in FIG. 4). The interdiffusion of the interfacial adhesion material and the conductive material is non-uniform. It is contemplated that the resulting tooth-like structure 451, 452 (shown in FIG. 4) of the interfacial adhesion material 450 (shown in FIG. 4) includes alloys of copper and palladium as well as areas of high percentages of palladium and areas of high percentages of copper..." (See page 5, line 29 to page 6, line 12 of the Specification portion of the application). The solid solution occurs after the molten metal formed is cooled, as depicted by the phase chart. Applicant submits that one of ordinary skill in the art would be enabled given the description of FIGs. 5A to 5E, the phase diagram and other discussions in the specification. It should also be noted that the claims themselves, as filed, are also part of the specification. These are another source of enablement.

With respect to claim 33, the Examiner contends that there is no explanation of how the structures are caused to be formed or how the interfacial adhesion material and the adhesion material interdiffuse. The interdiffusion is described in the specification at various places. One location sets forth that

“Heating the materials at the base of the via 4712 includes directing the energy of a laser 560 (see FIG. 5D) at the base of the via. Heating the materials at the base of the via 812 includes heating the materials at the base of the via to a temperature within the range of 400-600 degrees C. The interfacial adhesion material interdiffuses with the conductive material. In some embodiments, the interdiffusion of the interfacial adhesion material and the conductive material is nonuniform and forms teeth-like structures that extend into the conductive layers at the base of the via.” (See page 10, lines 16-24 of the Specification).

Metals in a liquid state interdiffuse at different rates. This is known. The fact that the phase diagram shows and is discussed with respect to cooling a molten metal to a solid state leaves little question for one skilled in the art as to enablement of this invention.

The explanations with respect to claims 26, 27, and 31-33 are equally applicable to claims 34 and 39. Accordingly, the rejection of 26-27, 31-34, and 39 under 35 USC § 112, first paragraph, is overcome.

C. Rejection: Claims 1, 4, 23-27, and 31-35 were rejected under 35 USC § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

D. Response: Applicant, in the following paragraphs, discuss either actions taken that overcome a rejection under 35 USC § 112, second paragraph, or reasons why applicant feels there is no basis for a rejection under 35 USC § 112, second paragraph.

Claim 1 has been amended to include a first conductive material and a second conductive material. Claims 11 and 12 were also amended to make them consistent with amended claim 1.

Claim 4 has been amended to particularly point out and distinctly claim the subject matter applicant regards as the invention.

Claim 27 has been amended to particularly point out and distinctly claim the subject matter applicant regards as the invention. Specifically, the claim refers to the “conductive layer”.

Claim 33 has been amended to particularly point out and distinctly claim the subject matter applicant regards as the invention. Specifically, claim 33 recites structures of alloys of the two layers.

Claims 23-27 have been amended to particularly point out and distinctly claim the subject matter applicant regards as the invention.

Claim 32 is reciting a new portion of an element that starts with the phrase “a solution”. Generally, when reciting a new element the indefinite article is used. Since applicant is introducing a new portion of the element, the phrase “a solution” appears to be appropriate and there is no need to set forth antecedent basis.

In view of the reasons set forth above and the corresponding amendments to some of the claims, Applicant respectfully submits that claims 1, 4, 23-27, and 31-35 now overcome the rejection under 35 USC § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

§102 Rejection of the Claims

A. Rejection: Claims 1, 5-6, 11, 13, and 21-24 were rejected under 35 USC § 102(a) as being anticipated by Chan et al. (U.S. 6,495,200 B1).

B. Response: Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Dillon* 919 F.2d 688, 16 USPQ 2d 1897, 1908 (Fed. Cir. 1990) (en banc), cert. denied, 500 U.S. 904 (1991). It is not enough, however, that the prior art reference discloses all the claimed elements in isolation. Rather, “[a]nticipation requires the presence in a single prior reference disclosure of each and every element of the claimed invention, *arranged as in the claim*.” *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added).

Claim 1, as amended, recites “...directing energy to the base of the opening to heat the materials at the base of the opening.” Chan et al. fails to teach this element. Chan et al. teaches a general heat treatment not directed toward a the base of the opening, such as the thermal treatment of layer 17A (See element 203 of FIG. 3 of Chan et al.). Chan et al. also teaches heating one material rather than “...the materials at the base of the opening.” In Chan et al. only the seedling layer is heated (See column 4, lines 30-35 of Chan et al.). Since Chan et al. fails to

disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 1 now overcomes the rejection under 35 USC § 102(a) as being anticipated by Chan et al. (U.S. 6,495,200 B1).

Claims 5, 6, 11 and 13 depend from claim 1 and include the recitations of claim 1 by their dependency. Accordingly, claims 5, 6, 11 and 13 now also overcome the rejection under 35 USC § 102(a) as being anticipated by Chan et al. (U.S. 6,495,200 B1).

Claim 21, as now amended, recites "...heating the interfacial adhesion layer and the conductive layer to form a solution that cools and includes teeth-like structures." Chan et al. fails to teach this heating step or the teeth-like structures that result. Since Chan et al. fails to disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 21 now overcomes the rejection under 35 USC § 102(a) as being anticipated by Chan et al. (U.S. 6,495,200 B1).

Claims 22-24 depend from claim 21 and include the recitations of claim 1 by their dependency. Accordingly, claims 22-24 now also overcome the rejection under 35 USC § 102(a) as being anticipated by Chan et al. (U.S. 6,495,200 B1).

C. Rejection: Claims 1, 4, 11-13, 21, 25, 31, 35, 36, 38, and 40 were rejected under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

D. Response: Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Dillon* 919 F.2d 688, 16 USPQ 2d 1897, 1908 (Fed. Cir. 1990) (en banc), cert. denied, 500 U.S. 904 (1991). It is not enough, however, that the prior art reference discloses all the claimed elements in isolation. Rather, "[a]nticipation requires the presence in a single prior reference disclosure of each and every element of the claimed invention, *arranged as in the claim*." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added).

Claim 1, as amended, recites "...directing energy to the base of the opening to heat the materials at the base of the opening." Kailasam fails to teach this element. Kailasam teaches a general heat treatment not directed toward a the base of the opening. Kailasam teaches that

the“...wafer is then heated and exposed to a precursor 56 to form the desired adhesion layer of boron, carbon, silicon, titanium nitride, or tantalum nitride.” (See paragraph 40 of Kailasam). Since Kailasam fails to disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 1 now overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claims 4 and 11-13 depend from claim 1 and include the recitations of claim 1 by their dependency. Accordingly, claims 4 and 11-13 now also overcome the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 21, as now amended, recites “...heating the interfacial adhesion layer and the conductive layer to form a solution that cools and includes teeth-like structures.” Kailasam fails to teach this heating step or the teeth-like structures that result. Since Kailasam fails to disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 21 now overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 25 depends from claim 21 and include the recitations of claim 21 by its dependency. Accordingly, claim 25 now also overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 31 recites the step of “...stitching the interfacial adhesion layer and the conductive material, wherein stitching the interfacial adhesion material and the conductive material includes forming teeth-like structures that extend into the conductive layers at the base of the via.” Kailasam fails to teach the stitching step or forming teeth-like structures as now recited. Since Kailasam fails to disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 31 now overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 36 depends from claim 31 and include the recitations of claim 31 by its dependency. Accordingly, claim 36 now also overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 36 recites the step of “...interdiffusing the interfacial adhesion layer and the conductive material to form tooth-like structures to stitch the interfacial adhesion layer and the

conductive material.” Kailasam fails to teach the interdiffusing step to form tooth-like structures as now recited. Since Kailasam fails to disclose each element of the claim under consideration, the Examiner has failed to make a proper *prima facie* case of anticipation. Accordingly, claim 38 now overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

Claim 40 depends from claim 38 and include the recitations of claim 38 by its dependency. Accordingly, claim 38 now also overcomes the rejection under 35 USC § 102(e) as being anticipated by Kailasam et al. (U.S. 2005/0181598).

§103 Rejection of the Claims

A. Rejection: Claims 2 and 3 were rejected under 35 USC § 103(a) as being unpatentable over Chan et al. (U.S. 6,495,200 B1) in view of Cohen et al. (U.S. 2005/0215046 A1).

B. Response: In order for the Examiner to establish a *prima facie* case of obviousness, three base criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference or references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *M.P.E.P.* § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991)).

Claims 2 and 3 depend from claim 1 and include the recitations of claim 1 by their dependency. Claim 1, as amended, recites “...directing energy to the base of the opening to heat the materials at the base of the opening.” Chan et al. fails to teach or suggest this element. Chan et al discloses a general heat treatment not directed toward a the base of the opening, such as the thermal treatment of layer 17A (See element 203 of FIG. 3 of Chan et al.). Chan et al. also discloses heating one material rather than “...the materials at the base of the opening.” In Chan

et al. only the seedling layer is heated (See column 4, lines 30-35 of Chan et al.). Cohen et al. also fails to teach or suggest this element. Since neither Chan et al. nor Cohen et al. teach or suggest all the claim limitations, the Examiner's case is not a proper *prima facie* case of obviousness. Accordingly, claims 2 and 3 now overcome the rejection under 35 USC § 103(a) as being unpatentable over Chan et al. (U.S. 6,495,200 B1) in view of Cohen et al. (U.S. 2005/0215046 A1).

C. Rejection: Claims 2 and 3 were rejected under 35 USC § 103(a) as being unpatentable over Kailasam et al. (U.S. 2005/0181598) in view of Cohen et al. (U.S. 2005/0215046 A1).

D. Response: In order for the Examiner to establish a *prima facie* case of obviousness, three base criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference or references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *M.P.E.P.* § 2142 (citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991)).

Claims 2 and 3 depend from claim 1 and include the recitations of claim 1 by their dependency. Claim 1, as amended, recites "...directing energy to the base of the opening to heat the materials at the base of the opening." Kailasam fails to teach or suggest this element. Kailasam discloses a general heat treatment not directed toward a the base of the opening. Kailasam discloses that the "...wafer is then heated and exposed to a precursor 56 to form the desired adhesion layer of boron, carbon, silicon, titanium nitride, or tantalum nitride." (See paragraph 40 of Kailasam). Cohen et al. also fails to teach or suggest this element. Since neither Chan et al. nor Kailasam teach or suggest all the claim limitations, the Examiner's case is not a proper *prima facie* case of obviousness. Accordingly, claims 2 and 3 now overcome the

rejection under 35 USC § 103(a) as being unpatentable over Kailasam et al. (U.S. 2005/0181598) in view of Cohen et al. (U.S. 2005/0215046 A1).

Allowable Subject Matter

Claims 7-10 and 37 were objected to as being dependent upon a rejected base claim, but were indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. By this amendment, claim 7 was rewritten in independent form and should be in an allowable form.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney ((612) 373-6977) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

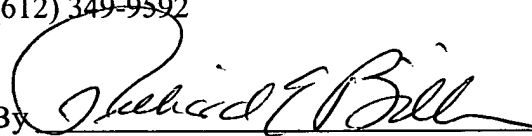
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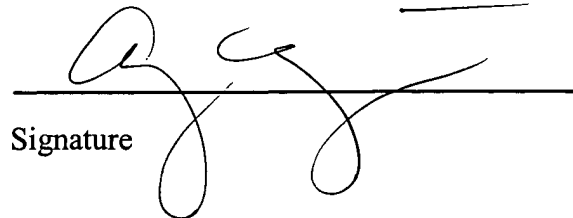
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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: MS Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 31st day of January, 2006.

Name

Amy Moriarty

Signature



IN THE DRAWINGS

Objection: Drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference characters "550" and "555" have both been used to designate the interfacial layer, sometimes called the interfacial adhesion.

Response: The interfacial layer 550 and the interfacial adhesion layer 555 are two different layers associated with an example embodiment described in the specification. Therefore, one layer is not being described with two different reference numbers. This is supported by FIGs. 5A to 5E as well as by FIG. 8 and the discussion of the flow chart found on page 10, line 10 to page 10, line 23 of the specification. As a result, applicant submits that an amendment to the drawings is not needed.